INFORMATION AND FORMULAS FOR COMPOUNDING

DIGNAN DIVIDED COLOR DEVELOPING SYSTEMS

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Our first thoughts on compounding a divided color developer centered on the aspects of what transpires when an A/B bath is utilized. When an emulsion is placed in the A bath (color prebath) and then transferred to a B bath (color activator) our assumption is that chemicals in both solutions are diluted by approximately 50%. This prompted us to experiment with increasing the usual amounts of the various chemicals that could be placed in the A bath.

To prevent any chemical action in the A prebath required that this solution should be compounded to have an acid pH. Studying the effect of pH of gelatin in The Theory of the Photographic Process* leads to information on the swelling of gelatin at various pH's. It is a well known fact that acid processed gelatin swells the least at the iso-electric point of pH 4.8. Not utilized is the information that swelling is greatest at a pH of 2.5 to 3. The curve in Mees' book (page 66) shows that swelling is much greater at 2.5 than it is at pH 13. Our original prebath was compounded with a pH of approximately 3. Our hope was that the emulsion would absorb the prebath more rapidly at this low pH.

The premise that both solutions are diluted, plus the low prebath pH, led to our increasing the pH of the activator to approximately pH 11.8.

All of the various developing agents commonly available were examined and the most promising was Kodak CD-4 (4-amino-3-methyl-N-ethyl-N-(β-hydroxyethyl)-aniline sulfate).

Rather startling results were produced by increasing the sulfite content of the prebath. The rules governing color compounding teaches us that large amounts of sulfite cannot be used in developing solutions, because the products of oxidation of the developing agents are needed to transform the couplers to dye. It was surprising to find that from two to three times the normal amount of sulfite could be used which actually accelerated development. The keeping properties of the prebath are greatly extended by the acid pH and additional sulfite.

The next problem that confronted us was fog. How much bromide or antifog could or should be used? Also, should these ingredients be placed in the A or B bath, or both. We found that the normal amounts of antifog would retard or stop development. The usual amount of bromide had the same effect. Note that the present kits contain 2. milligrams of benzotriazole per liter of activator. Increasing this amount to 4. m/gs reduces color saturation by about 50%.

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*C.E. Kenneth Mees, Copyright 1954

Although the system of maintaining the prebath at pH 3. functioned correctly, the transfer of an emulsion to the B bath at pH 11.8 evolved sulfur dioxide which was extremely annoying, especially if the solutions were used in trays and without good ventilation. So the idea of using a low pH was finally abandoned. However, before the low pH prebath was discarded, processing was attempted in drums such as the Unicolor unit. The low pH system produced uneven development and some means was sought to lubricate the emulsion. After testing a number of wetting agents, ammonium lauryl sulfate was used which not only solved the uneven development problem, but also increased color saturation. This reaction was predictable because ammonium lauryl sulfate has been recommended as a developing accelerator.

A surprising effect was ammonium lauryl sulfate's solvent action on benzyl alcohol. Benzyl alcohol will go into solution much more rapidly in an acid solution containing ammonium lauryl sulfate.

As pointed out above, the idea of maintaining the prebath at pH 3.0 was finally discarded and the pH was increased to 6.5. We found that at pH 6.5, development in the prebath still did not take place. The solutions keeping properties were increased rather than decreased. Also the rate of development in the activator was not decreased. Increasing the prebath pH accomplished two things. The solutions did not generate sulfur dioxide, at least not in obnoxious amounts. Also the amount of acid carried-over into the activator was greatly reduced, which extended the life of the activator. These methods form the basis of our present kits.

The following formulas represent a compromise in results versus economy of compounding the solutions. For example, CD-4 in the paper developer can be increased. We have not attempted to decrease the amount below the working level of 15. grams. The amount of sodium sulfite was chosen to produce the 6.5 pH. Changing the amount of CD-4 or sodium bisulfite will change the amount of sulfite needed.

Other alkalis besides potassium carbonate can be used, or a combination of alkalis could be used. The main requirement is the pH should not drop below 11.2. At pH 11. there is a definite decrease in development. *

NCF-41

The information gained in compounding the paper developer was used to compound the film developer. In this instance, we found that better results were produced by moving the bromide to the B bath along with the two milligrams of benzotriazole. The use of the film activator as a one-shot showed that this solution could be diluted 100% and still produce consistent results.

The literature on DIR couplers points out that the inter-image effect is affected by the couplers which actually produce a benzotriazole type compound during processing. This may account for the small amount of this chemical needed when emulsions such as Kodacolor II and Vericolor II , containing DIR couplers are processed in these solutions.

*Approximate Print Kit pH 12.2

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CORRECTED FORMULA FOR

DIGNAN DIVIDED COLOR PRINT DEVELOPER

AS OF 12-1-1979

COLOR PREBATH

Distilled Water	800.0 ml
Sodium Bisulfite	2.0 grams
*CD-4	6.0 grams
Benzyl Alcohol	25.0 ml
Ethylene Glycol	30.0 ml
Ammonium Lauryl Sulfate (15%)	5.0 ml
Sodium Sulfite (anhy.)	5.0 grams
Potassium Bromide	250.0 milligrams
Benzotriazole	2.0 milligrams
Beta-phenethylamine	1.5 ml
Distilled water to make	1.0 liter

pH at 75°F 6.8

* CD-3 = 8.8 g

COLOR ACTIVATOR

Distilled Water	700.0 ml
Potassium Carbonate (Anhy.)	75. to 80. grams
Distilled water to make	1.0 liter

pH at 75°F 11.8 to 12.2

REMAINING FORMULAS AND STEPS REMAIN THE SAME

CONFIDENTIAL REPORT #2

NEW INFORMATION ON DIGNAN DIVIDED PRINT DEVELOPER

The original concept of our Divided Print Developer prebath used a relatively large amount of sulfite and bisulfite, plus a large quantity of the Kodak Color Developing Agent CD-4.

The pH of the prebath was very low for the reasons given in our first report.

The pH of the color activator was higher than most commercial color developing solutions.

One of the main problems with our original chemistry, was the REVERSE activity of the prebath. As the time and/or temperature was increased, color saturation decreased. This was not an easy problem to solve or even recognize. Because of past experience, we refused to believe what our eyes and our densitometer told us. We searched a long time analyzing every conceivable variable, and of course there were many.

When we finally accepted this REVERSE action of the prebath, our efforts were directed to make the system less critical. Our conclusions about keeping the pH low proved not to be the best method. By increasing the pH to 6.5 and finally to 6.8 we found that we could decrease the total amount of alkali in the activator. This in turn decreased the amount of stopbath required. We also moved the anti-fog in the prebath, which allowed us to package the activator as a powder. Decreasing the amount of sulfite, helped eliminate the problem of short prebath time. We finally added beta-phenethylamine in the prebath. This color excellerator allowed us to again reduce the total amount of alkali necessary in the color activator solution. We also increased the amount of ethylene glycol and benzyl alcohol and reduced the amount of bromide.

The Print Kits that we have been supplying for the last six months were compounded using the following formulas:

COLOR PREBATH

Distilled Water	800.0	ml
Sodium Bisulfite	2.0	grams
CD-4	6.0	grams
Benzyl Alcohol	25.0	ml
Ethylene Glycol	30.0	ml
Ammonium Lauryl Sulfate (15%)	5.0	ml
Sodium Sulfite (anhy)	5.0	grams
Potassium Bromide	250.0	milligrams
Benzotriazole	2.0	milligrams
Beta-phenethylamine	1.5	ml
Water to make	1.0	liter
pH at 75°F	6.8	-

COLOR ACTIVATOR

Distilled Water	700.0	ml
Potassium Carbonate (anhy)	75 to 80.0	grams
Distilled Water to make	1.0	liter
pH at 75°F	11.8 to 12.2	

STOP BATH (PRINT & NCF-41)

Water	700.0	ml
Sodium Diacetate	125 to 130.0	grams
Water to make	2.0	liters
pH at 75°F	4.6	-
NOTE: For NCF-41,		
Water to make	4.0	liters
pH at 75°F	4.8	-

BLEACH/FIX (PRINT & NCF-41)

Water	600.0	ml
Ammonium Thiosulfate (60%)	120.0	ml
Sodium Sulfite (anhy)	10.0	grams
Ferric Salt, EDTA	100.0	grams
EDTA, Na_4	5.0	grams
Ammonium or Sodium Thiocyanate	5.0	grams
Water to make	1.0	liter

NOTE: Use Sodium Carbonate or Sodium Bisulfite to adjust pH at 75°F to 6.8

PAPER STABILIZER

Water	800.0	ml
Citric Acid (mono)	6.8	grams
Acetic Acid (glacial)	12.5	ml
Sodium Hydroxide (45% sol*)	4.5	ml
Sodium Benzoate	0.34	gram
Water to make	1.0	liter
pH at 80.6°F	3.6	-

*Adjust pH with Hydroxide

PROCESSING CHART FOR DIVIDED COLOR PRINT DEVELOPING SYSTEM

	68°F ± 2°F	72°F ± 2°F	76°F ± 2°F	
1. COLOR PREBATH	1 Min.	45 Sec.	30 Sec.	Return Prebath to Storage Bottle
2. COLOR ACTIVATOR	3½ Min.	2-2 ½ Min.	2 Min.	Discard After Use
3. RINSE - One 30 Seconds Rinse PLUS One Minute STOP BATH				
4. PRINT MAY BE REMOVED FROM DRUM IN ROOM LIGHT				
5. BLEACH/FIX - 2 to 4 Minutes				
6. WASH	6 Min.	5 Min.	4 Min.	
DRY BEFORE JUDGING COLOR BALANCE				

Drum must be thoroughly washed and dried before re-use.

NOTE: Do not use a water pre-wet before Prebath. Discoloration of solutions, when using Kodak RC is not oxidation.